where there was an excess, and the blue lines where there was a deficiency. The general results are that, in each hemisphere, pressures are highest in winter, and lowest in summer; that in winter the highest pressures are grouped over the continents, and in summer the lowest, and that in winter very low pressures prevail in the northern parts of the Atlantic and Pacific oceans respectively. The position of the isobars is wholly determined by the relative distribution of land and water.

As regards wind, those places were selected which are favourably situated for observing its direction. In calculating the average direction, the element of force was wholly excluded. The years were, so far as possible, the same as those for which the mean pressure had been calculated; but where this was not possible, care was taken to see that a good average was in every case obtained. The mean direction of the wind for each month is shown in the charts by arrows.

Thus two quite distinct facts were exhibited on the charts, viz. lines showing the mean pressure of the atmosphere, and arrows showing the prevailing winds at the earth's surface, each being independently arrived at by the summing and averaging of observed facts. What relation is there between these two classes of facts?

1. *As regards regions of Low Pressures:*

In every case where such occur at any season, it is universally seen that the relations of the winds to the isobaric lines is exactly the same that is illustrated in every storm of wind when the winds and pressures are set down in synophic charts.—The relation is this; the wind neither blows round the centre of least pressure in circles, nor as tangents to the concentric isobaric curves, nor does it blow directly towards that centre, but it takes an intermediate direction, approaching however more nearly to the direction and course of the circular curves than of the radii to the centre. The angle is not a right angle but from about 60° to 80°. Thus the whole system of winds seem to blow vorticosely in upon the spaces of low pressure. This is the relation known as *Buy's Ballot Law of the Winds.*

2. *As regards regions of High Pressures:*

In all cases where such occur, the winds are seen to flow out in every direction. In these cases also, the behaviour of the winds differs in no respect from what occurs on particular days on which the isobaric lines present the same conditions of pressure. The winds flow out of these spaces of high pressure in courses exactly the opposite to what takes place when they flow in upon spaces of low pressure, and hence such meteorological phenomena have been called by Mr. Francis Galton, "Anticyclones." This is also, it will be seen, in strict accordance with Buy's Ballot Law. Hence then this broad result is arrived at, viz., that the prevailing winds over the globe at all seasons obey Buy's Ballot Law, with reference to the distribution of atmospheric pressure.

The *outflow* of the air from a region of high pressure, and the *inflow* upon a region of high pressure is reducible to the single principle of gravitation, and so marked is this, that if there be any other force or forces which put the winds in motion, they must be altogether insignificant as compared with gravitation.

The annual averages of the 115 places distributed over the north temperate zone were minutely examined with the view of ascertaining how far the commonly-alleged prevalence of equatorial and polar currents is borne out by observation. The result of the analysis is this:—There are two maximum directions of prevailing winds at the stations of which the S.W. and N.E. at Greenwich may be taken as an example. The chief prevailing winds of the north temperate zone blow from some point from S.S.W. to W. (the true equatorial direction) at 41 per cent. of the stations, leaving 59 per cent. at which they are from other points of the compass. And the secondary prevailing winds come from some point from N.N.E. to E. (the true polar direction) at 34 per cent. of the stations or only a third of the whole. Hence whilst the largest percentage of prevailing winds are in the direction in which truly equatorial and polar winds should blow, the percentages from the direction are so large as to preclude the supposition of a general flow of the surface winds of the temperate zone towards and from the polar regions. The truth is, it is not the poles of the earth, but the regions of high and low pressures which must be regarded as the true poles of the winds towards which and from which the great movements of the atmosphere proceed; and owing to the unequal distribution of land and water, the poles of pressure and movements of the atmosphere are, as in the case of the poles of temperature, very far from being coincident with the North Pole.

The causes which bring about an unequal distribution of the mass of the earth's atmosphere are chiefly two—viz., the temperature principally, and secondarily the moisture of the atmosphere, their relations to the geographical distribution of land and water. The charts show that where there is an excess of temperature, as in the interior of Asia in summer, and where there is a relative excess of moisture, as in the belt of calms and in the north of the Atlantic in winter, and where there is an excess of cold, as in the interior of Asia in winter, and where there is a deficiency of moisture—there atmospheric pressure is high. Hence where pressures are low there the air is specifically light, and where pressures are high there the air is heavy relatively to that of surrounding regions.

Further, since vast columns of air are poured by the prevailing winds into those regions where pressures are low without increasing that pressure, we must suppose that there is an outflow from these regions through upper currents, and this inference is all the more inevitable, seeing that the specifically light air resting over these regions supplies the conditions of an ascending current. Again, since vast volumes of air are driven off from the regions of high pressure without diminishing the pressure, it must be inferred that the high pressure is maintained by accessions poured in upon it by the upper currents, and this inference is the more certain because in such regions the air is relatively heavier than in surrounding regions, thus supplying the conditions of a descending current.

It is evident that the currents from the regions of low pressure will continue to ascend as long as their pressure is less than that in regions surrounding them *at the same height*, but that as soon as they reach a height where the pressure is less, towards and over that region will they flow as upper currents of the atmosphere. The courses of these upper currents will be directed towards those regions where the air is coldest and driest near the surface of the earth, because being thereby densest, the great mass of the air will condense in the lower beds, thus leaving less air or a diminished pressure in the upper regions. Thus the high winter pressure of Asia will be maintained by air being poured upon it by upper currents from the regions of low pressure in the north of the Atlantic, the north of the Pacific, and the Equatorial regions of the south.

From these considerations the following *Theory of the Movements of the Earth's Atmosphere* necessarily follows. The winds on the surface of the earth are known from the isobaric lines, the direction being from regions of high towards regions of low pressures, subject to the changes produced in the direction of the currents by the earth's rotation; and the upper currents of the atmosphere may be inferred from the isobaric lines taken reversely together with the isothermal lines taken directly. In other words, the regions of lowest pressure, by giving the ascending currents, point out the sources or fountains whence the upper currents flow; and the isothermal lines, by showing where, on account of the low temperature, the greatest portion of the air is condensed in the lower beds and so diminishing the pressure in the upper beds, point out the regions towards and over which the upper currents diffuse themselves.

In this discussion of the prevailing winds and mean atmospheric pressure over the globe, there is contained the first approximate answer to the two questions:—

1. What are the motions of the earth's atmosphere?
2. What are the causes of these motions?

It has been shown by Dr. Balfour Stewart[*] that these questions form the first two stages in the development of meteorology. Considering the importance of the subjects of this discussion which enter deeply into Physical Geography, Geology, the Science of Navigation, and the General Physics of the globe, it is to be hoped that observation will be made and turned to account in rectifying the isobaric lines and filling up the blanks of the winds over the ocean, and portions of Africa and South America, data from these regions being in this as well as every similar discussion to a large extent wanting. ALEX. BUCHAN

SOCIETIES AND ACADEMIES

LONDON

Zoological Society, November 15.—Prof. W. H. Flower F.R.S., V.P., in the chair. An eighth letter was read from Mr. W. H. Hudson, containing further observations on the Ornithology of Buenos Ayres.—Mr. Sclater exhibited a specimen

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See NATURE of December 2, 1869, p.129.

of the new Australian Mudfish, recently described by Mr. Krefft in the Society's "Proceedings" as *Ceratodus forsteri.* This specimen had been obtained from the Mary River, Queensland, and forwarded to Mr. Sclater by Mr. E. P. Ramsay.—Dr. J. Murie read a memoir on the form and structure of the Manatee (*Manatus americanus*), as deduced from a fresh specimen of this animal forwarded to this Society in a living state by Mr. G. W. Latimer, of Porto Rico, in April 1866, but which had unfortunately died just before reaching Southampton.—A communication was read from Mr. Morton Allport, relating to the progress of the experiments for introducing Salmon and Trout into Tasmania.—Professor Flower read a memoir on the anatomy of the Panda (*Ailurus fulgens*), as deduced from a specimen of this animal which had been presented to the Society by Dr. Simpson, in May 1869, and had lived for some time in the Society's Gardens. After an elaborate examination of every part of this animal, Professor Flower came to the conclusion that it belonged to the Arctoidean group of the Carnivores, and was most nearly allied to the Raccoons and other members of the family *Procyonidæ.* Mr. Bartlett read some notes chiefly on the habits of the same animal, as observed when living in the Society's Gardens.—A communication was read from Dr. J. E. Gray, containing the outlines of a new arrangement of the Delphinoid Whales.—A communication was read from Mr. W. Harper Pease, containing remarks on the Mollusks of the genus *Triphoris* and descriptions of some new species.—Mr. A. G. Butler communicated a notice of some abnormalities observed in the neuration of the hind wings in *Acræa andromacha.*—A paper was read by Dr. A. Günther containing descriptions of two new species of Lizards of the genera *Eumeces* and *Calotes*, proposed to be called *E. brachydactylus* (from Pegu) and *C. jerdoni* (from the Khasya hills).—A paper was read by Messrs. Sclater and Salvin on the recent collections of Venezuelan birds made by Mr. A. Goering in the vicinity of Merida. The present collection was stated to embrace examples of 105 species, nine of which were considered to be new to Science. Amongst the latter were two new Parrots, proposed to be called *Urochroma dilectissma* and *Conurus rhodocephalus.*—A communication was read from Mr. H. Adams, containing descriptions of 27 new species of Shells collected by Mr. R. McAndrew in the Red Sea. A second communication from Mr. Adams contained descriptions of a new genus and four new species of Shells from Borneo and other localities.

Anthropological Society of London, November 15.—Dr. Charnock, V.P., in the chair; H. R. Adam, and David [illegible] were elected fellows. Dr. R. H. Bakewell read a paper on "The Condition of the Blood-corpuscles in certain Races." The author's researches had been undertaken at the request of Dr. Barnard Davis, F.R.S. While investigating the pathology of malarious fevers, the writer made numerous microscopical examinations of the blood, both of the sick and the healthy, in Trinidad. On comparison of the various races of English, French, Portuguese, Italians, Germans, Indians, Chinese, Africans (both indigenous and of West Indian birth), and Creoles of various breeds, he found that, besides the differences produced by disease, there were well-marked differences between the various races. The corpuscles of the flesh-eating Mussulman and the vegetable-feeding Hindoo were contrasted, and it was found that the Hindoo's blood contained a much larger number of white corpuscles, the red corpuscles also differing in form from those of the Mussulman. The author coined the word "nummulation" for the phenomenon observed in the aggregation of the corpuscles like *rouleaux* of coin. He gave the results of the examination of the blood of about a hundred different persons.—Mr. C. Staniland Wake, Director A.S.L., then read a paper on "Tribal Affinities among the Aborigines of Australia." After tracing the distribution of the several forms of native habitations, canoes, and weapons, and also of certain burial customs and initiatory rites, and referring to the apparently universal practice of cannibalism and blood-revenge, the writer stated, firstly, that the phenomena presented by the generality of the western natives are, on the whole, of a more simple character than those exhibited by the other aborigines agreeing with the milder disposition they apparently possess; secondly, that the southern and eastern natives agree generally in their customs with the aborigines of the western part of the continent, but that they present certain peculiarities which seem to suggest an internal influence. This influence must have proceeded from the north, and there the very customs of phenomena which constitute the differentia between the natives of the west and those of the east are met with. Comparing the distribution of initiatory rites with that of other customs, it would seem that scarifying the flesh and nose-perforation are, like the use of the semi-circular hut, primitive customs at one time common to all the aborigines; that the custom of removing a front tooth is almost limited to the canoe-making peoples of the north, south, or east, who also possess in common certain funeral rites unknown to the western natives; whilst circumcision is limited to the northern and southern tribes and to some intermediate ones. The final conclusion of the paper was, that the western natives represent the most primitive and simple form of the Australian stock, the natives of the south and east having been intermixed with fresh comers from the north, who introduced new customs. This southward movement was in two directions—one across the continent to the head of the Great Bight, thence spreading east and west along the coast; the other along the north and eastern shores, and gradually spreading over the eastern portion of the continent.—Dr. Robert Peel contributed a communication on Australian Aborigines and Half-Castes, and exhibited skulls (which he had presented to the Society's Museum) in illustration.

Chemical Society, November 17.—Prof. Williamson, F.R.S., President, in the chair. The following papers were read:—"Mineralogical Notices," by Prof. Maskelyne and Dr. Flight. The contents of this communication were—1. On the formation of basic cupric sulphate. In 1867 M. Pisani described a mineral which he supposed to be the Woodwardite of Mr. Church. The substance, however, is not the latter mineral. It had previously been examined in the Laboratory of the British Museum, and the results sufficiently tallied with those of M. Pisani to identify the mineral. The only interest this mineral offers is in the light it seems to throw on the possible modes of the formation of native basic cupric sulphates. The actions of solutions of magnesium or calcium sulphate on malachite may terminate in the production of langite. An experiment in the laboratory showed that an insoluble cupric sulphate and acid magnesium carbonate were actually formed. 2. Opal from Waddela Plain, Abyssinia. Mr. Markham presented to the British Museum some remarkable specimens of green opal from the above locality, Its analysis showed it to consist of about 92 per cent. of silica, 6 per cent. of water, and the remainder was iron, manganese, calcium, and magnesium. 3. Francolite, Cornwall. Its analytical numbers point to the formula

$$5\left.\begin{matrix}[3\,\mathrm{Ca},\ 2\,(\mathrm{P\,O_4})]\\ \mathrm{Ca\,CO_3}\end{matrix}\right\} + 2\,\mathrm{Ca\,F_2}$$

It is, in fact, a fluor-apatite, in which one equivalent in every six of the calcium phosphate is replaced by carbonate. The crystallography of this mineral seems also to point to its not being ordinary apatite, and in fact to its not being the same mineral as the original francolite from Wheal Franco. 4. Epidote and serpentine, Iona. A pebble in which a green mineral traverses bright red felspar and quartz in veins was sent by the Duke of Argyll to the British Museum. Its analysis leads to the view that it consists of a lime epidote with some 23 per cent. of quartz, the former mineral having the following constitution:

$$3\,[2\,\mathrm{Ca\,O},\ \mathrm{Si\,O_2}] + 2\,[2\,(\tfrac{3}{5}\mathrm{Al}\ \ \tfrac{2}{5}\,\mathrm{Fe})_2\,\mathrm{O_3},\ 3\,\mathrm{Si\,O_2}]$$

Two specimens of serpentine from the same locality gave the general formula:

$$3\,\mathrm{R''\,O},\ 2\,\mathrm{Si\,O_2},\ 2\,\mathrm{H_2\,O},$$

where R represents in one case Mg, with a little Fe and Ca; in the other Mg, with nearly one-fifth of its equivalent of an equal mixture of Fe and Mg. 5. Vivianite. Two kinds of this mineral were found in an unknown Cornish locality. The one is of a pale, bluish tint, the other of a brownish colour. Both proved to be octahydrated ferrous orthophosphate, $3\,\mathrm{Fe\,O},\ \mathrm{P_2\,O_5},\ 8\,\mathrm{H_2\,O}$, and the difference in the colours can only be ascribed to some minute difference in the degree of oxidation of the iron. 6. Cronstedtite. The analysis of this mineral presented considerable difficulties, inasmuch as it was extremely difficult to free it from the substances with which it is found associated. The cronstedtite in question possesses an unusual interest from a crystallographical point of view, being one of the best defined types of hemimorphism. 7. Pholerite. This mineral, derived from India, is of a pale flesh white, penetrated in several places by patches and veins of a black mineral. A new name was proposed for this mineral, but the analysis shows it to be nothing but pholerite. Mr. Church observed that it was a matter of congratulation to have those beautiful specimens which are stored in our magnificent national collections investigated in so excellent a manner as the contents of the paper just read have shown.—The next communication was a note by Mr. Chapman "On the Oxides of Nitrogen." In a paper read at the last meeting of the Chemical Society, Mr. Chapman mentioned that he had quantitatively estimated nitric oxide by converting it into nitric acid, and determining the latter by the production and weighing of the baryta salt. Objections were then raised as to the possibility of the completeness of such a conversion. Mr. Chapman now endeavoured to show by referring to well-known chemical facts that whether N_2O_5, N_2O_4, or N_2O_3 be formed when NO is left with excess of oxygen over water, the final result must be the transformation into nitric acid. Mr. Harcourt reasserted that on his passing nitric oxide into oxygen he obtained as result nitric peroxide; when reversing this order and passing oxygen into nitric oxide, a mixture of N_2O_4 and N_2O_3 seems to be formed. Mr. Chapman replied that the different results obtained by Mr. Harcourt and by himself were in all probability due to differences of the temperatures at which the respective experiments had been executed. Prof. Williamson took occasion of this repeated mentioning of nitric peroxide to remark that this compound may be viewed as $\left.\begin{matrix}NO\\NO_2\end{matrix}\right\}O$, *i.e.*, as water in which the one hydrogen was replaced by NO, the other by NO_2.

Linnean Society, November 17.—Dr. J. D. Hooker, V.P., in the chair. Notes on the *Passifloreæ*, by Dr. M. T. Masters. The paper treated of the morphology of the whole order, including the organography of all the genera; the minute anatomy, development, mode of fertilisation, and the movements which take place in the stamens and pistils of *Passiflora;* the affinities of the order, together with an inquiry into the value of characters, and the mode of estimating them; a complete list of the genera and species, with detailed descriptions of all the species which are not either American or African, and which will be published elsewhere; and, lastly, an account of the geographical distribution. (1.) Organography.—The tendrils, as shown by their development, minute anatomy and position, and the fact that they occasionally bear flowers, are merely modified flower-stalks. The leaf, whether single or divided, always commences in development at the apex, and proceeds from above downwards. There are only three bracts instead of five, as there would be in a perfectly symmetrical arrangement; their position, as well as that of the other parts of the flower, relative to the axis has been somewhat incorrectly described by Payer, Griffith, and Schleiden. Jussieu and St. Hilaire held that there is no true corolla in the passion-flowers, but two calycine whorls, because both organs fall at the same time. But the mode of development and the internal structure clearly demonstrate that the inner whorl is a true corolla; the calyx is quincuncial, while the petals appear simultaneously. The flower-tube is, according to Bentham, composed of a union of the calyx and corolla; Dr. Masters, on the other hand, believes it to be an expansion of the axis. Its development is comparatively late. The form of the corona was traced from its simplest form in *Turnera* to its most complicated arrangement in some Modeccas and Passifloras, in all cases it is a mere projection from the flower-tube, and is of late development, and morphologically of little importance, though essential to the individual life of the plant. The inner portion of the tube is a glandular secreting surface. Each separate thread of the corona has its own distinct vascular bundle. The stamens, unlike those of *Cucurbitaceæ*, are not perigynous, but truly hypogynous. The gynophore becomes gradually developed, raising the stamens with it. The anthers are invariably two-celled. The pistil is singularly uniform, one-celled, made up of three united carpels, with three parietal placentæ and three stigmas. (2.) Mode of Fertilisation.—The arrangement of the sexual organs favours cross-fertilisation. The anthers, originally introrse, become, when fully developed, distinctly extrorse, and it is thus rendered difficult for the pollen to fall on the stigmas of the same flower; it falls on to the rays of the corona, on which insects alight in search of the honey concealed at the base of the tube, and carry the pollen away to other flowers. Some species are more easily fertilised by pollen belonging to a different species than by their own; hence hybridisation abounds. (3.) Affinities.—Dr. Masters connects the *Passifloreæ* rather with the *Turneraceæ*, *Samydaceæ*, *Violaceæ*, and *Sauvagesieæ* than with the *Cucurbitaceæ*, chiefly on account of their truly hypogynous stamens. (4.) Geographical Distribution.—The order is essentially tropical, occurring between 30° N. and 30° S. latitude. Taking the genus *Passiflora* as the type, it is almost exclusively American, and chiefly Brazilian; a few outliers of the true passion-flowers occur in Madagascar and Mauritius, the latter probably introduced, and in North America there is a very remarkable form, the *P. incarnata*, or original passion-flower of the Jesuits; it is an annual, and apparently an alien, but remarkably uniform and invariable; its representative in Brazil is *P. edulis*, a shrub, and an extremely variable plant. On the western side of the Andes you get entirely different forms, especially the *Tacsonias*, which have generally a much longer flower-tube. In India there are a few species, not belonging to the American section of the order, but to the *Polyanthea*, which are found also in Ceylon and the Indian Archipelago, and one outlying species in an island near Hong Kong. In Australia and the Pacific Islands occurs another perfectly distinct group; in New Zealand a perfectly distinct form is met with; and, again, another in Africa, where no true passion-flower is indigenous, except the one in Madagascar; the species here, few in number, belonging to six or eight distinct genera.—"On the White-beaked Bottle-nosed Whale," by Dr. Jas. Murie. The paper gave an account of several anatomical points in the structure of this whale, which had not been clearly described before. The little bag or sac connected with the double articulation between the lower jaw and the rest of the skull, which is found in all Mammals except the Cetacea, is however, present in the fœtus of the latter.

Mathematical Society, Nov. 10.—Prof. Cayley, President, in the chair. The following gentlemen were elected to form the council for the Session 1870–1:—President, W. Spottiswoode, F.R.S.; Vice-Presidents, Professors Cayley, Henrici, and H. J. S. Smith; Treasurer, Dr. Hirst; Hon. Secs., M. Jenkins and R. Tucker; other Members, W. K. Clifford, T. Cotterill, M. W. Crofton, *C. W. Merrifield, *J. F. Moulton, J. Stirling, Archibald Smith, Prof. Sylvester, J. J. Walker. Mr. J. J. Hamblin Smith, M.A., Caius College, Cambridge, was proposed for election. The new president having taken the chair, called on Prof. Cayley to read his paper, of which an abstract is given below—"Sketch of Recent Researches upon Quartic and Quintic Surfaces." The classification of quartic surfaces is, even as to its highest divisions, incomplete; and it is by no means easy to make it at once exhaustive and precise; an examination of all the *prima facie* possible cases would include forms which do not really exist. Premising that the expression "singular" means double or cuspidal, or refers to a higher singularity; "nodal" in general double (including the signification cuspidal), we may provisionally arrange the non-scrolar quartic surfaces as follows—1, without a nodal curve; 2, with a nodal line; 3, with a nodal conic, or line-pair; 4, with three nodal lines (not in the same plane) meeting in a point); 5, the quartic scrolls, omitting altogether the torse and cones. For the scrolls the division into twelve species appears to be complete (Memoirs by Cayley (3) (4), Cremona, and Schwarz). As regards non-scrolar surfaces, we have—1. Without a singular curve. The surface may be without a cnicnode (conical point), or it may have any number of cnicnodes up to 16 (Cayley, (5); Kummer (1) (2),). It may be remarked that the wave-surface, or generally the surface obtained by the homographic deformation of the wave-surface, called by Cayley (1) (2) the "tetrahedroid," is a special form of surface with 16 nodes. 2. Quartic surface with nodal line. Considered incidentally in *Clebsch* (2) (3). 3. Quartic surfaces with nodal conic. Such a surface may be without cnicnodes, or it may have one, two, three, or four cnicnodes. The cases other than that of three cnicnodes are mentioned, *Kummer* (1); but the question is examined and the remaining case of three cnicnodes established, *Cayley* (6). The general case of the nodal conic without cnicnodes is elaborately considered, *Clebsch* (1). See also *Geiser;* the several cases of one, two, three, and four cnicnodes are considered, *Korndorfer*. In the case where the nodal conic is the circle at infinity the surfaces have been termed "anallagmatic" (perhaps "bicircular" would be a more convenient name), and a great deal has been written on these surfaces by Moutard, Clifford, and others. The theory of the quartic surfaces with a cuspidal conic has been hardly at all considered, briefly referred to in *Cayley* (6), also in *Cayley* (8). "I do not know that anything has been done in regard to the quartic surfaces where the nodal conic becomes a line-pair, that is, where we have two intersecting nodal lines." 4. Quartic surface with three nodal lines (not in the same plane) meeting in a point. This is in fact *Steiner's* quartic surface, and it has been the subject of numerous investigations. The author then proceeded to speak of the paper, *Kummer* (1), which discusses the cases in which a quartic surface has upon it a system of conics; or what is the same thing, in what cases there is a system of planes each intersecting the surface in two conics. It is, in the first place, remarked that there is no proper quartic surface cut by every plane in a pair of conics or even a proper quartic surface cut in a pair of conics by every plane through a fixed point. The cases considered are:—(I.) where the planes are non-tangent planes; (II.) where they are single tangent planes; and (III.) where they are double tangent planes (*Steiner's* surface, where every tangent plane meets the surface in a pair of conics, comes under II.). It was then pointed out that several of the papers by *Clebsch* and others, refer in their titles to the "Abbildung" of a surface, viz. they show that a (1,1) correspondence exists between the points of a surface and the points of a plane. For surfaces of the higher orders it is only certain surfaces which admit of an "Abbildung," or (1,1) correspondence of the points thereof with the points of a plane; viz. a surface, in order that it may thus correspond with the plane, (or say in order that it may be unicursal), must have a sufficient singularity in the way of a nodal or cuspidal curve. In the memoir *Clebsch* (3), after explaining the above method of the transformation of a cubic surface by means of two of the lines thereof, the author goes on to notice that the like method is applicable to certain quartic and quintic surfaces, viz. (1) quartic surfaces with a nodal conic; (2) quartic surfaces with a nodal line; (3) quintic surfaces having a nodal skew cubic (the nodal skew cubic may break up into a conic and line which meets it, or into three lines, two of them not meeting each other, but each met by the third line; and the like theory applies to these quintic surfaces). The memoir by *Korndorfer* relates to the "abbildung" of a quartic surface having a nodal conic, and one, two, three, or four cnicnodes. *Clebsch* (4) relates to the "abbildung" of a quartic scroll. "As regards quintic surfaces (not being scrolls), we have, so far as I am aware, only the paper *Clebsch* (3) relating to quintic surfaces with a nodel Skew Cubic; the paper *Clebsch* (5), which relates to the 'abbildung' of a quintic surface having a nodal quadriquadric. It only remains to speak of *Schwarz's* memoirs on Quintic Scrolls: it is to be remarked that the theory of scrolls is allied more closely with that of plane curves than with that of surfaces, viz. considering any plane section of the scroll the lines of the scroll have in general a (1,1) correspondence with the points of the plane section, and the scrolls of any given order are properly arranged according to the deficiency of the plane section. This is what is done in the memoirs by *Cremona*, and this is the principle of classification in *Schwarz's* memoir. A model of Steimer's surface was exhibited, and many of its properties pointed out. The following list of memoirs will indicate the sources whence the sketch was principally drawn. Memoirs by the author: (1) Sur la Surface des Ondes. Liouville, tom. xi. 1846. (2) Sur un cas particulier de la Surface du quatrième ordre avec seize points singuliers. Crelle, tom. lxv. pp. 284—290. (3.) Second memoir on Skew Surfaces otherwise Scrolls. Phil. Trans. vol. cliv. (1864), pp. 559—577. (4.) Third memoir. Phil. Trans. vol. clix. (1869), pp. 111—126. (5.) A memoir on Quartic Surfaces. Proc. of London Math. Society (1870), vol. iii. pp. 19—69. (6.) On the Quartic Surfaces $(*\ \divideontimes,\ U,\ V,\ W)^2=0$, Quarterly Journal of Math. tom. x. (1868), pp. 24—34. (7) Do. tom. xi. pp. 15—25 (1870). (8.) Memoir on Cubic Surfaces. Phil. Trans. vol. clix. (1869), pp. 231—326. *Cremona:* Sulle superficie gobbe di quarto grado. Mem di Bologna, tom. viii. (1868). *Schwarz:* Ueber die geradlinigen Flächen fünften Grades. Crelle, tom. lxvii. (1867), pp. 23—57. *Clebsch* (1) Ueber die Flächen vierter Ordnung welche eine Doppelcurve zweiten Grades besitzen. Crelle, tom. lxix. (2.) Intorno alla rappresentazione di superficie algebriche sopra un piano. Atti di R. Ist. Lomb. (1868), 13 pages. (3.) Ueber die Abbildung algebräischer Flächen insbesondere der vierten und fünften Ordnung. Ann. Clebsch und Neumann, vol. i. (1868), pp. 253—316. (4.) Ueber die ebene Abbildung der geradlinigen Flächen vierter Ordnung welche eine Doppelcurve dritten Grades besitzen. Ann. Clebsch und Neumann (1870), pp. 445—466. (5.) Ueber die Abbildung einer Classe von Flächen, 5 Ordnung. Gött. abh. tom. xv. 64 pages. *Geisser:* Ueber die Flächen vierten Grades welche eine Doppelcurve weiten Grades haben. Crelle, tom. lxx. (1868), pp. 249—257. *Korndorfer:* Ueber die ebene Abbildung Clebsch und Neumann, tom. ii. *Kummer:* (1) Ueber die Flächen vierten Grades auf welchen Schaaren von Kegelschnitten liegen. Berl. Monatsber. Jul. 1863. Crelle, tom. lxiv. (1864), pp. 66—76. (2) Ueber die algebräischen Strahlensysteme ins besondere über die der ersten und zweiten Ordnung. Berl. abh. (1866), pp. 1—120. (3.) (Surfaces of the 4th order with sixteen conical points). Berl. Monatsber. (1864), pp. 246—260, and 495—499.

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* These gentlemen were not on the Council for the Session 1869–70.

Meteorological Society, November 16.—Mr. C. V. Walker, President, in the chair. Mr. J. H. Gilbert, Mr. C. R. Marten, Mr. F. E. Sawyer, and Mr. T. H. Wilson were elected Fellows. A paper was read by Mr. G. Dines, "On Evaporation and Evaporation Gauges, with some remarks upon the Formation of Dew," in which, after referring to Dr. Dalton's investigations, he explained the experiments in which he has been engaged during the past eighteen months with gauges of different sizes, the experiments being made sometimes with water of ordinary temperature, and at other times with heated water and also with water artificially cooled, in the open air and in a closed room. Mr. Dines then gave the results of these experiments, one of which confirmed the statement of Mr. Glaisher in 1847, viz. that "the formation of dew was found to depend solely on the temperature of the bodies upon which it was deposited, and that it never appeared upon them till their temperature had descended below that of the dew-point in their locality." Finally, he stated that the conclusions which he had arrived at were, 1st. The greatest cause of evaporation is the movement of the air. 2nd. Whatever tends to increase the temperature of the air increases evaporation, and *vice versâ*; and 3rd, That which tends to lessen the temperature of the dew-point, increases evaporation, and *vice versâ*. Mr. Glaisher then made a communication respecting the November meteors, giving the results of the watches which were kept during the nights of the 12th-13th, 13th-14th, and 14th-15th. On the latter evening fifty-three meteors were observed. He also made some remarks on the great magnetic disturbances which occurred during the brilliant display of Aurora Borealis on the nights of October 24th and 25th. The President then adjourned the meeting till January 18, 1871.

MANCHESTER

Literary and Philosophical Society, October 4.—Rev. Wm. Gaskell, Vice-president, in the chair. Mr. Boyd Dawkins gave a short account of the work done in the Victoria Cave, near Settle, since the last notice brought before the Society. The two layers containing traces of man were separated at the entrance by a talus of fallen stones, seven feet thick, that gradually coalesced as the excavation passed into the cave, and at last became so confused together as not to be easily distinguished at a few feet from the entrance. The remains of a gigantic bear which had been eaten may probably be assigned to the lower horizon, which furnished flint-flakes, and a bone harpoon in form resembling that used by the natives of Nootka Sound; the upper or Romano-Celtic stratum continued to supply evidence of the comparatively late date of its accumulation in barbarous imitations of coins of Tetricus (A.D. 267-273.) A portion of the ivory handle of a Roman sword and a coin of Trajan have also been found, along with large quantities of the bones of animals that had been used as food. Several spurs of cocks proved that the inhabitants ate the domestic fowl, which was probably imported into this country either directly or indirectly by the Romans. The most striking object, however, is a beautiful sigmoid fibula made of bronze, and ornamented with a beautiful pattern in red, yellow, green, and blue enamel. It is an admirable example of the art of enamelling ("Britannicum opus"?) which the Celtic inhabitants of Britain probably taught their Roman conquerors.

October 18.—Mr. E. W. Binney, President, in the chair. Prof Balfour Stewart, F.R.S., exhibited a series of sun-spot curves projected from results obtained by himself and Mr. De La Rue, from observations of Schwabe, Carrington, and the Kew series of photographs of the sun. These extend over a term o about forty years, and exhibit a principal and secondary maximum and minimum in each solar spot period of eleven years, thus corresponding with the light curves of R Sagittæ observed by Mr. Baxendell, and β Lyræ by Prof. Argelander. Hence i may possibly be that notwithstanding the darkening of the sun's surface during the maximum spot period, the total light and hea emitted by the sun at this period is really greater than at th times of minimum spot frequency.—Mr. Lockyer, F.R.S., gav an account of his recent spectroscopic investigations of the sola atmosphere, and pointed out that the conclusions arrived at b De La Rue, Stewart, and Loewy, confirmed the views to whic he himself had been led by spectroscopic observations of th sun during the last two or three years. These tended to show that the absorbing atmosphere, termed the chromosphere, which he had proved to exist round the sun's body, had gradually diminished in thickness since the last solar spot minimum in 1867.—Mr. Boyd Dawkins, F.R.S., gave a short account of the examination of Offa's Dyke made in the autumn by Col. Lane Fox and himself. The portion examined extended from Cherbury in the south to the abrupt range of limestone hills to the north of Llanamynech. At Nantcribba Hall, near Forden, the dyke passes nearly due north between the road to Montgomery and the abrupt boss of volcanic trap which looks at a short distance like a ruined castle, and which has been encircled by a very broad and deep moat. There can be no doubt but that this was a point of observation, and as it is but some twenty yards on the English side of the dyke, it was most probably one of the permanent positions occupied by the English followers of the Mercian King From this point the dyke gradually swerves to the east from the road between Montgomery and Buttington, and makes directly over the low slopes of the hills, in some places being nearly ploughed down, and in others, and especially in the small valleys, being of considerable height and resembling a railway embankment, until it reaches the higher ground of Fron. Thence it runs through Pentre and gradually approaches the road, and finally dies away in the alluvium of the Severn, nearly a quarter of a mile to the south of Buttington Church. The commanding camp to the south of this portion of the line is Caer Digol, or the Beacon Ring, on the top of the Long Mountain. The morass, which in Offa's time must have extended between the main ditch and the Severn, prevented the necessity of any bank being made between Buttington and the Cefn. Where, however, the open country demands a defence to the north of Cefn, an embankment makes straight for the Greenstone ridge of the Garreg, and is very plainly seen close to the farm-house of that name, near the Trewern Gate. Here we lost our clue, and it is very likely that the steep ridges of Moel y Golfa, and the marvellously strong camps of the Breiddan and Middleton Hills, formed a sufficiently strong barrier without any dyke being raised. We picked it up again, however, on the western or Welsh side of the Severn, from which it runs, as shown in the Ordnance map, due north to the four crosses, where it joins the Oswestry road, and where it is cut across by the new railway. There it makes straight for the fortified hill of Llanamynech, its line coinciding with the high road. On reaching the summit of Llanamynech it takes the western or Welsh side of the two large camps, and passes down into the valley to the south of Whitehaven, which was the limit of our expedition. The results of our examination are the direct proof that the dyke was made for military purposes, and that it took the line which was best adapted for repelling the incursions of the Welsh. Throughout the district which was examined the embankment faces Wales, and was therefore made to defend the country within it from the Welsh. Dr. Wright's view, therefore, that it was a mere geographical boundary to prevent the Welsh from stealing the cattle of the Mercians cannot be maintained, although it may perhaps receive some confirmation from the nursery legend of Taffy. The camps in the neighbourhood of the dyke are probably older than Offa's time. The bronze spears found in Llanamynech imply that the camp is not later than the bronze age, while the Roman coins in that of the Breiddan point to its occupation by the Romans.

November 1.—Rev. William Gaskell, Vice-president, in the chair. Mr. William H. Johnson, Mr. Walter Morris, and Professor Balfour Stewart were elected ordinary members of the Society. Dr. Joule exhibited a series of curves obtained by Dr. Stewart from the self-recording instruments at the Kew Observatory, showing a large amount of disturbance of the magnetic declination and horizontal force during the progress of the aurora of the 25th October. He also showed a curve of the changes which took place in the magnetic dip as observed by himself at Broughton. The most remarkable variation occurred during the interval from $6^h\ 15^m$ to $6^h\ 23^m$ G.M.T., when the dip increased from 69° 8′ to 70° 30′.—"Notes on Glacier Moraines in Cumberland and Westmoreland," by Mr. Brockbank, F.G.S. The author referred to the proceedings of the Geological Society of London for 1840–1, which contain notices of the evidences of glaciers having existed in Great Britain, by Professor Agassiz, Dr. Buckland, and others, and which point out (1) "Moraine-like Masses of Drift," which occur near the junction of the Eamont and Lowther with the Eden, near Penrith; (2) The "large and lofty insulated piles of gravel in the valley of the Kent near Kendal, and the smaller moraines and their detritus, which nearly fill the valley from thence to Morecambe Bay;" (3) "Similar mounds near Shap," and (4) the "Gravel mounds near Milnthorpe and thence to Lancaster." Of these the author considered the Kentmere Group, near Kendal, as most nearly fulfilling the conditions required in true glacier moraines, and that in the other cases it admitted of doubt whether they were really due entirely to glacial action. The districts more particularly the subjects of the author's notes are (1) the valleys of Eskdale and the Duddon (which were not visited by Dr. Buckland, but in which he supposed moraines to exist, from the appearances of the valleys as delineated in Fryer's map of Cumberland); (2) the valleys eastwards from Bowfell; and (3) the district of Shap Fells.

DIARY

THURSDAY, November 24.

London Institution, at 7.30.—On the Precious Metals and their Distribution: Prof. Morris

Royal Society, at 8.30.—Note on the Pendulum Observations in India: Col. J. T. Walker, F.R.S.—The Theory of Resonance: Hon. J. W. Strutt.

Society of Antiquaries, at 8.30.—Romano-Celtic Sword exhibited by Lord Wharncliffe: Mr. A. W. Franks.—Wall Decorations of the Roman Period in Sectile Work, especially in Glass: Mr. A Nesbitt.

SUNDAY, November 27.

Sunday Lecture Society, at 3.30.—On the Antiquity of Man: Dr. Cobbold

MONDAY, November 28.

London Institution, at 4.—On Chemical Action: Prof. Odling

Institute of Actuaries, at 7.—On Legislation in reference to Life Insurance and Life Insurance Companies: Mr. T. B. Sprague, M.A.

TUESDAY, November 29.

Geographical Society, at 8.30.

Manchester Literary and Philosophical Society, at 7.

WEDNESDAY, November 30.

Society of Arts, at 8.—On Peat and its Profitable Utilisation: Robert M. Alloway.

THURSDAY, December 1.

Chemical Society, at 8.—On some Derivatives of Anthracene: Mr. W. H. Perkin.

Linnean Society, at 8.

London Institution, at 7.30.—On Gems and Precious Stones: Prof. Morris.

Society of Antiquaries, at 8.30.

TUESDAY, December 6.

Anthropological Society, at 8.—On the Races inhabiting the British Isles: Mr. A. L. Lewis.—On Archaic Structures of Cornwall and Devon: Mr. A. L. Lewis.—On Forms of Ancient Interment in Antrim: Dr. Sinclair Holden.

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Errata.—Page 28, second column, line 10, for "cumulus" read "nimbus." Page 54, first column, line 25 from bottom, for "Mr. Care" read "Mr. Earl."